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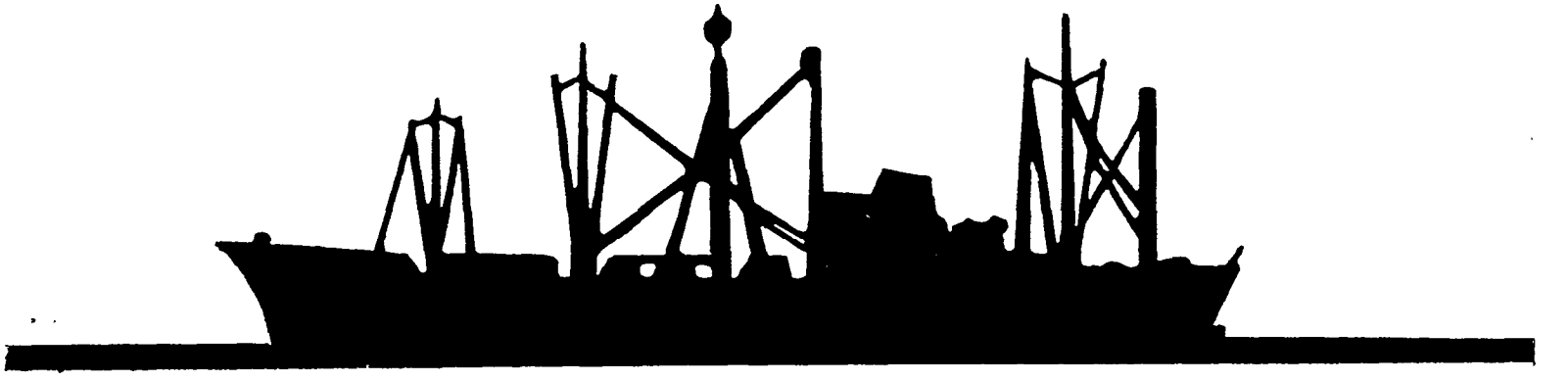

INSTITUTE FOR RESEARCH AND ENGINEERING FOR AUTOMATION AND PRODUCTIVITY IN SHIPBUILDING

I R E A P S

MOST COMPUTER SYSTEMS: INTER-SHIPYARD DATA TRANSFERABILITY

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ABSTRACT

Over the past year and a half, five participating shipyards have been preparing labor time standards using MOST Computer Systems on a time sharing basis. The result has been the development of separate databases covering the following operating areas: blast and paint--platen and dock areas; Electrical--shop and outfitting; main assembly; fabrication shop; and staging erection and teardown--platen, dock and ways. The ability to transfer data from one yard to another is discussed, as well as the methodology for such transfer. The actual use of transferred data and its application is covered to the extent that it has occurred up to the date of the symposium.

Introduction

One of the features. of the MarAd SF-8 Panel's FY81 project for Labor Standards, has been the use of a common Data Base **within** the time shared MOST Computer System. The practice is a cost effective method of introducing Computer MOST to the shipyard industrial engineering groups. At the same time, the future transfer of data had been considered to be possible, but not necesarily probable.

In fact, the Panel had intended to establish a system of Standard Data that would indeed be useable by the shipbuilding industry. At the present time, that step is. still in the future. However, there is a considerable degree of interest in the feasibility of data transfer in order to expand the coverage within a yard on a timely basis - and without greatly expanding the industrial engineering group.

By early spring 1982, we had reached the conclusion that the transfer of data was feasible. A few tests conducted at the participating yards - particularly at Bethlehem Steel's Sparrows Point yard - taken in conjunction with the work done on data adaptation for Peterson Builder's Pilot Program for Pipe Shop Scheduling, and a Gross Estimating System for Newport News, provided the basis for the conclusion.

Summary

The data that is available is sufficient to cover between 50% and 80% of shipbuilding operations. **By** using the transfer approach, a yard can achieve full coverage of its shipbuilding operations in approximately one half of the time required to develop al 1 of the data from scratch.

Transferabi1ity is NOT applicable to completed Time Standards that apply to complete components of a ship. Even if two yards are building the same ship, there are enough differences in work methods and processes to make it more than doubtful that the same labor hours apply.

The transfer of sub-operation data is feasible -- and desirable in terms of time and cost.

Process Data MAY BE transferable. Process times developed for machinery and equipment is transferable for like machinery and equipment, as long as the process time is essentially machine controlled.

Welding process. times ARE transferrable, for similar' welding methods, equipment and electrodes - particularly when the data is taken from the Welding Module of Computer MOST.

In all cases, some additional data wi11 have to be developed, since there are differences in processes, and in the scope of work covered by specific crafts and trades.

Data transfer is considered to be more economical than completely new data development for at least two reasons. First, there are very few yards that have an established Work Measurement group within their Industrial Engineering Section. (If they DO have an Industrial Engineering Section.) Regardless of the background of the analyst selected, the transfer of data provides an invaluable training method either in the use of manual or Computer MOST, or in making the analyst knowledgeable about a given work area.

Second, there is a significant saving in the time required to develop data.

Defining Transferability

"The quality or state of being transferable." That is the Webster definition for transferability.

With respect to Work Measurement Data, there are two sub-definitions that must be added:

1. Transferabi1ity 'as is'

2. Transferabi1ity - with modification.

Transferabi1ity 'as is', may be defined as the direct use of work measurement data elements at locations other than those where the data was developed. Data considered to be tranferable "as is", wi11 be referred to as 'transfer data'.

Transferability - with 'modification, may be defined as the modification of work measurement data elements to accomodate different work place or work area layouts and arrangements found at other than the location where the data was developed, Further, modification may. be required for process time values. Data considered to be transferable with modification will be referred to as 'modified data'.

Accuracy and Precision

Before proceeding, it is important to establish the accuracy levels required for the application of work measurement data, and the precision required, in shipbuilding.

The shipbuilding industry (with a few exceptions) does not have a background of work measurement application as a management tool. Nevertheless, the industry has used and is using a version of

labor standards for bidding, planning, scheduling and man1oading. The data used is most often based on historical information gathered on a return cost basis. Return cost be ing defined as the time values reported and co11ected through the existing accounting system and budget procedures.

Without discussing or attempting to evaluate the accuracy of the return cost data, let's consider the validity of 'historical'standards.

Historical time values have the disadvantage of including every mistake, error and delay that has occurred. Whether or not 'improvement factors.' are used to reduce the historical time, there is seldom a factual relationship between those improvement factors (e.g., historical average 1ess 10%) and what may be the time that is genuinely required.

Given the fact that workers wi11 at tempt to acheive a work time target, budgets WILL be matched **3.5** long as they are not beyond the capacity of the worker as an individual or as a group. Only supervisory ability wi11 lead a group to perform under budget - and the 'unusual occurance' (such as a crane breakdown) is a ready reason for 'over budget' events -- even though such delays are a part of the historical time used to establish the original budget .

The introduction of work measurement techniques to establish Labor Standards provides a degree of accuracy that has been previously unknown. But, it is not practical or realistic to anticipate that a shipyard will - or can - immediately convert from existing practice to a rigid management control system based on accurate 1abor standards. It IS practical and realistic to expect that a shipyard wi11 prefer to use accurate data in conjunction with sound estimating and risk factors to improve and expand their management control tools.

All of which leads to the conclusion that labor data used should be accurate within the normal limits of work measurement (+/- 5%) but should not be required to match the precision expected of standards used in most manufacturing operations.

MOST systems include a recognition of the accuracy requirements for al 1 work measurement techniques -- and continues to provide a precision of five decimal places in the developed data. The experiences of the past year have demonstrated that in most cases, a precision of three, two, or even one decimal place is both practical and suitable for shipbuilding.

Impact of Data Application

Considering the requirements of accuracy and precision, there are two application areas that may not be suitab1e for the use of data transferred from other shipyards. Those areas are:

1. Labor Incentive Systems, and

2. Labor Performance Reporting and Analysis coupled with supervisory accountability.

Those areas require the use of data that is both accurate and traceable to provide management with the back-up required to secure supervisory and worker cooperation. Data accuracy is also required to provide the background necessary to modify the standards as methods, processes and conditions change. Transfer Data will satisfy the requirements, but could require as much time and effort for validation as it would take to develop site specific data. Modified Data could require as much or more time to develop than would site specific data.

Wherever Work Sampling Studies are used to develop modifiers for the determination of 'application standards', and wherever judgement factors (or risk factors) are applied, both Transfer and Modified Data are applicable.

Data Review

Since the Standards program began in late 1979, a total of ten Work Management Manual (WMM) sets have been produced, six of them by manual methods, and four by computer. Those sets are:

A. Manually prepared:

1. Bath Iron Works, a) Hardings Plant C Bay; b) Hardings Plant B Bay; and c) Hyde South Assembly Building.

2. Bay Shipbuilding, a) 'All' -a general manual; and b) Graving Dock & Platen Area.

3. National Steel and Shipbilding, a) 'All' - a general manual; b) Panel Line; and c) Platen Area.

4. Newport News Shipbuilding and Dry Dock, Blast and Coat - Platen and Graving Dock.

5. Peterson Builders, Pipe Fabricating Shop.

6. Sun Ship, Blasting and Coating Facility.

B. Computer prepared:

7. Bath Iron Works, Main Assembly Building.

8. Bethlehem Steel , a) General , Temporary Staging for Ground Assembly and Aboard Ship; b) Wire Rope Handrai 1 for Ground Assembly; c) Pipe Staging for Aboard Ship, and d) Bracket Staging for Aboard Ship.

9. National Steel and Shipbuilding, a) General for NASSCO Plate Shop ; b) Brackets; c) Foundations; and d) Ladders.

10. Peterson Builders, a) Electrical General - Electrical Work for Shipboard Installation; b) Shoot Studs on Bulkhead in Ship; c)_ Cut 25WU-7 Cable; d) Pack MCT Onboard Ship; e) Prepare Electrical Box for Installation Aboard Ship; f) Install Electrical Switch Aboard Ship; g) Terminations at Electrical Panels; h) Attach Plug to the End of Designated Cable; and i) Test Distribution Panel #500 VAC.

The appendix is an index of the data available, covering thirteen work areas, and five types of ships.

The overall quality of the material in terms of its transfer-ability, ranges from Good to Excellent. The following general comments are in order.

The various Glossaries that are appended to many of the manuals do not provide definitions for some "local" terms. Whenever there are questions about the meaning of some terms, it is recommended that a call be made to the appropriate yard to get a definition of the terminology used. Unless such an approach is taken, useful data may be discarded through misunderstanding. Of course, if definitions are assumed, some data may end up being misused.

Most manuals provide sketches of the products involved that also serve as a definition of the operation covered, and of the terminology used.

The work area and workplace layouts provided in the computer prepared manuals may seem to include several duplicates. In fact, the duplication is of the arrangement, but not of the tools, or equipment or spatial relationships covered.

The material contained in the Newport News manual (Blast and Paint on Platen and in Dock<) has been prepared with Maxi-MOST, and requires an understanding of that technique before use.

Al though each data set was developed for a particular type of ship under construction, the bulk of the operations are

independent of ship type. Of course, there are those operations required for HY-80 steel that are exclusive to Navy construction, but those factors affect the coverage available, not the validity of the data.

Personnel Requiremnts

As a general rule, it is more cost effective to select personnel who have knowledge of the work area and the capability to be trained in Industrial Engineering techniques, rather than trained analysts who have no knowledge of the work area to be covered. Frequently the best candidates may also be candidates for first line supervisory positions. A temporary appointment to the Industrial Engineering group should be considered as an excel lent training step for line promotion.

There are situations that may dictate how personnel are selected, and what the source will be. In most situations, training will be necessary. Whether the training must be in the work area involved, or in MOST, the transfer of data provides a superior 'on the job' training procedure.

When MOST analysts who are unfamiliar with the work area must be used, the transfer technique becomes a training aid, as well as a way of reducing data development time.

Reference to an existing WMM is an excellent method for introducing the analyst to the work methods and procedures of the area to be covered. By having hard copy of the sub-ops in hand when he goes to the shop, he has a guide to understanding what he sees. At the same time, he can readily evaluate how much of the data is usable, and where he must develop new data.

When adding someone familiar with the work, but who needs to be trained as an analyst, the transfer concept is a most useful training device. The basic 'classroom' training cannot cover all of the situations the analyst will encounter, and it seldom provides the kind of practical guidance for sub-operation structure that analysts can only glean from the guidance of an outside consultant, or from the experienced analysts in the yard, or from three to four months of trial application. The data transfer technique will provide important guidance in sub-op structure, and will accelerate the new analyst's learning curve.

Transfer Procedure

The actual 'manipulation' of existing data is the primary difference in the use of transfer and 'modified data between those who use manual MOST and those who have the advantage of Computer MOST. A review of the procedures involved, provides an' excel lent evaluation of the advantage of transferring data over the development of new data.

1. New Data development:

   a. Visually analyze overall 1 operation and record:
      1) Work Area (sketch)
      2) Operations performed, manual and machine.
      3) Number of operators.
      4) Tools and equipment used.
      5) Distances between work places.

   b. In note form (while at workplace) write step by step procedure for doing the work.

   C. Transcribe notes and information to MOST forms.

   d. Write up the sub-operation? determining MOST sequence and segment valves.

   e. Calculate the sub-op time value.

Maynard experience indicates that the above procedure will require approximately 10 hours of analysis for each hour of work analyzed.

2. Transfer Data using Manual MOST:

   a. Using a hard copy of the existing sub-operation and its accompanying layout, visually or synthetically analyze the overall sub-op. Annotate hard copy to indicate the differences found, and to check the similarities. Check the arrangement and distances on the layout.

   b. If necessary, prepare a revised work place layout .*

   C. If necessary, rewrite the sub-op methods steps, and the appropriate MOST sequences and segment values.

   d. Calculate the revised sub-op time value, or accept the existing sub-op and its time value.

Depending on the ski 11 and knowledge of the analyst and the amount of revision required, between 4 and 8 hours of analyst time is required per hour of work analyzed.

3. Transfer Data using Computer MOST:

   a. Same as step 2a, above.

   b. If necessary, use the computer to edit the work place layout to the noted configuration and distances. *

   C. If necessary edit the methods steps in the computer. If the only change is the layout and associated distances, allow the computer to recalculate the sequences and time values.

d. Al low the computer to calculate the sub-op time value.

Depending on the ski 11 and knowledge of the analyst, and the extent of modifications required, between 2 and 5 hours of analyst time is required per hour of work analyzed.

* When the analyst determines that the distances are within the range of the MOST Index, changes are not required. See Figure 1.

In consideration of the vast amount of different work involved in the shipbuilding process, anything that promises to reduce analyst time without sacrificing accuracy should be a desirable action. In most Industrial Engineering Departments, available standard data is used whenever the accuracy and precision provided is within the requirements of the manufacturing operations.

Data Transfer and Work Methods

With few exceptions, we do not train shipfitters (or other craftsmen in shipyards) in the better methods of work that may be available.

For example, we have found a variety of tools and methods used by electricians for stripping wire leads. Obviously, it is neither realistic nor practical to prepare data for each method encountered.

The accepted practice is to prepare a sub-op for the most feasible - and better - method encountered. Where significant time differences exist, it has been the practice to prepare a methods improvement, and to work with shop management to insure that all of the workers have been instructed in the better method.

Obviously, the use of data transfer could and should have the same impact on methods in use. When a sub-op is reviewed for transfer, and there is a different method, consideration should be given to picking up the new method IF a savings is indicated.

Those yards that have existing standards - whether used for incentives not, should make a different evaluation of transferability. The data that is in the manuals may be used to review existing standards for completeness and accuracy. Certainly when time study has been the basis for the existing standard, the accuracy and completeness of data back-up that is available within the Work Management Manuals may be the basis for a planned conversion - over an extended period - from one system to another.

FIGURE 1

MOST Distance Ranges

MOST Index No.	Distance Range - in Steps From	Up to and Including
3	1	2
6	3	4
10	5	7
16	8	10
24	11	15
32	16	20
42	21	26
54	27	33
67	34	40
81	41	49
.	.	.
.	.	.
,	.	.
330	175	191

Conclusion

Over the past two years, MarAd has invested something over $1,250,000 in the development of Engineered Labor Standards for shipbuilding. The basic data developed during the programs is available to those shipbuilders who are interested.

Transferability is concerned with the ability of any yard to pickup and use data that has been developed. That ability exists. The sub-operation data is well developed, and can be used wherever the specific operation is used.

The coverage provided by the existing data varies from shipyard to shipyard, depending on what work is actually performed on the premises. For example, the Electrical Shop manuals provide coverage for the bulk of any electrical work. However, since the developing yard is small and purchases components and services to a greater extent than larger yards, there are additional operations at the larger yards that are not covered by the data. Also, cable sizes are relatively small, and the activity involved in pulling large and heavy cables is also not covered. Nevertheless, the existing data represents approximately 80% of the electrical work involved in shipbuilding.

The major activities NOT represented in the manuals are:

1. Warehousing
2. Material Handling
3. Sheet Metal fabrication and installation.
4. Pipe installation
5. Machine Shop
6. The installation of machinery, lighting, most out-fitting operations, and
7. Indirect operations such as Maintenance and Custodial.

Data transferability is feasible, and will provide coverage at 50% to 80% of the cost required to develop new data.

Those yards that have not participated and that do not have the resources to warrant the establishment of an industrial engineering group may not be in a position to take advantage of the mass of data that is curently available.

Hopefully, there wi11 be progress towards conversion of the data to a Standard Data format, and the provision of an application procedure that can be applied to almost any shipyard's operations, with a minimal technical staff requirement. Such a program is a logical extension of the SP-8 Panel's activity to develop and apply industrial engineering techniques within the shipbuilding industry.

Index of Data

I Pipe Fabrication - PBI (Patrol Gun Boat)

Covers pipe sizes through 8" Diameter; Copper , Copper Nickel, Mild Steel, Galvanized, and Stainless Steel pipe.

A. Bend Pipe - Greenlee Benders - 2", 4", and 6"
-* Conrac Bender - tooling for 2" through 4".
-* Anneal Copper pipe for bending.

B. Cut Pipe - Marvel Bandsaw. Includes debur, bevel and grind.

C. *Clean pipe after Conrac bender,

D. Use portable Bevel Grinder.

E. *Thread pipe on threading machine.

F. *Drill pipe for O'lets.

G. Braze pipe - use sil-braze rings.

H. Fit and Tack ferrous pipe.

I. Weld pipe in vise and in positioner.

J. *Inspect assemblies, cap and tape openings.

K. *Bolt Flange Assembly.

* Supplementary material not in original WMM.

II. Electrical Shop - PBI. (Patrol Gun Boat)

A. Cut Cable to Length at Cable Shed.

Includes measure on floor, cut, mark, tag, coil, tape and load cable on pallet for delivery to ship or to storage.

B. Prepare Electrical Boxes for installation.

Includes drilling holes, punching ho1es (porta-punch), and other operations necessary to get boxes ready for installation on ship.

C. Assemble Plugs.

Includes preparing cable, conductors and leads, placing of plug hardware, identification tubing, shrink tubing, soldering connections, and final assembly of plug.

D. Shoot Studs with Weld Gun.

Includes al 1 setups and operations required to weld studs to bulkheads or equivalent.

E. Pull Cable, Pack MCT (Multi-cable transit) .

Includes preparing cables for pulling, pulling through hangers, banding and tying in place on hangers, and the complete assembly of the MCT.

F. Install Electrical Equipment.

Includes al 1 operations {punch, drill, fasten) to install electrical boxes on ship.

G. Terminate Cables.

Includes installation of stuffing tubes on boxes, al 1 preparation of cables, conductors and leads for service loop and individual routings and connections. Labelling of leads, installation of lugs, and connections in boxes. Also covers installation of electrical components in boxes.

H. Test Fixture.

Includes al 1 operations required for megger testing.

III Panel Line - NSS (NASSCO) (Tanker)

A. Fit and Tack - ESAB Crane and Press.

Includes inspect and code plates, align plates, prepare to fit and tack', fit and tack, and moue panel to weld area.

B. Weld Panel

Includes moving tacked panel in, completed panel out. Set up and tear down of ground clamps, track, and sub arc mathine. Move track and machine to next seam, service machine with flux and wire, panel turnover, welding and filler pass.

C. Grind. Covers grinding weld for pickup.

IV Fabrication and Assembly of Small Components. - NSS (Tanker)

A. Brackets

Includes necessary setup, teardown and transport for burning machine, shear, brake press and C press for forming docking brackets.

B. Foundations

Includes necessary setups, tear downs, transport and operation for sawing, shearing, bending, punching, drilling, fitting (in jig) tacking and welding components for a typical foundation.

C. Ladders

Includes operations (see Foundations) necessary to fabricate and assemble ladders with handrails in jigs.

v Assembly of Small Components (Steel and Aluminum) - BIW (Fast Frigate)

A. Layout

Includes, get parts and place, get instructions, measure and mark, and moue marked parts to storage with location notation in log.

B. Fit and Tack

Includes get instructions, parts and fitting aids. Check layout as needed, transfer layout opposite hand, fit various parts and shapes, grind to fit, burn to fit, tack weld, and mark assembly identification and weld requirement.

c. Weld

Includes al 1 necessary set ups, moues (manual and crane) and cleaning operations to final weld assemblies.

VI Assembly of 'over-the-highway' transportable Bulkheads and Webs. - BIW (Fast Frigate)

A. Fit and Tack.

Includes get instructions, manual and crane transport, layout, mark, scribe, makeup, install, tack, and grind parts, and mark assembly with identification and weld data.

B. Weld

Includes al 1 necessary operations for manual (stick) and semi-automatic welding of assemblies.

VII Assembly of Curved Shell Sections - BIW (Fast Frigate)

A. Fit and Tack

Use IT 'Come-along', 6T Come-along, Porta-power jack, Dog and Wedge, Panel jack, and Bolt & Clip fitting aids. Land and fit plates to 'Mock'(permanent pin Jig) fit and tack plate seams, install strongbacks, layout for grinding and framing, land fit and tack stringers, webs, collars, headers, tanks (and regulate) brackets, stringers, chocks, etc. Mark assembly for welding.

B. Weld

Setup, prepare to weld, change rod and reel and clean weld area for manual and semi-automatic welding.

VIII Install and Remove Staging - BSC (Sparrows Point) (Tanker)

A. Wire Rope Handrails.

Al 1 necessary operations to erect and tear down welded and bolt-on stanchions, including nuts welded to web or bulkhead for stanchion service. Run and remove wire rope handrail.

B. Pipe Staging.

Al 1 necessary operations to erect end panels and braces, lay planks, erect stanchions and pipe rails. Transport by crane to material supply and to erection location, transport by hand to point of erection. Includes climb up and down.

c. Bracket Staging

Weld and burn bracket clip, ladder clip, stanchion and handrail. Set up and remove ladders, climb up and down ladders, and transport materials and tools by grove crane, winch, tower crane, and aerial platform. Erect and remove brackets, stanchins, rails, and planks.

IX Assemble Erectable Units on Platen - NSS (Tanker)

A. Layout

Establish squaring lines, horn/measure diagonals, use Steel Tape template to set frame and long lines. Snap chalk lines, centerpunch, use paint stick and stencil. Pitch two plates.

B. Burn Plate for butt fit

Set up for manual and Bug-O burning.

C. Fit

Moue and align panels, plates, and parts with porta-power, chain hoist, pry bar, and dog and wedge. Weld and remove fitting aids such as dogs, saddles, strongbacks, andclips. Fit and tack all parts such as plates, bulkheads, webs, longs, collars, padeyes, collars, curved plates, transoms, frames, floors, etc. Set up pin jig and plate stops.

D. Weld

Supply, set up and tear down operations for sub-arc, straddle buggy, electroslag, gravity feed and arc gouge. Use needle gun, and weld lugs.

E. Chip and Grind

Set up, tear down, and operate pneumatic chipper (chisel) and disc grinder.

X Assemble Erectable Units in Assembly Building - BIW (Fast Frigate)

A. Shipfitting - Steel - Upper unit, Lower unit and Join,

1. s-et up.

Steel plate, CVK assembly and main deck assembly on permanent jigs.. Seams, stringers, web frames, bulkheads and second deck assembly. set and regulate tank-top assembly unit in upright position in jig, and upper unit onto lower unit.

2. Layout

Shell for framing

3. Make-up

Stringer, web frame, stiffener tie-butts and bulkheads to bottom shell assembly and to deck.

4. Install and/or Combine

Collars, brackets, chocks, headers, intercostal frames, seachest, manholes, rings, foundations, stanchions, tanks, reefer skirting, bulkheads on deck, side shell to unit and cross-flooding baffles and enclosures.

B. Shipfitting - Aluminum deck house and superstructure.

1. Set Up

Deck on permanent jig and bulkhead on deck.

2. Make-ready

Deck for scribe, bulkhead on unit, and fitter for job.

3. Make Up

Deck seam or butt, stiffener connections on deck, bulkhead to deck, vertical seams, house side to deck and on unit, and web frames to transverse girders.

4. Install and/or Combine

Collars, brackets, foundations and headers.

C. Welding,' Steel and Aluminum

Per Foot values for all welds, and Per Piece values for typical aluminum components.

XI Blast and Paint in Facility - Sun (Container Ship)

A. Prepare for Blasting

Erect 1 adder and back rail, install lighting and ventilation and place rolling staging. Wrap pipe, values, fixtures and pipe ends. Suit up.

B. Blast (steel grit)

Moue staging and climb to change location.

C. Clean up

Get equipment and return.

D. Prepare Unit to Paint

Get and return materials, tools and equipment, suit up, moue staging, and climb to change location. Mask Edges and stripe.

E. Paint

Moue staging and climb to change location.

F. Clean up Unit

Remove back rail, ladder, ventilation, lighting, masking and rolling staging.

0. Clean Up. Facility

Scrape floor with "Bobcat" and shovel leftover grit.

XII Blast and Paint on Platen, In Dock - NNS (Tanker)

A. Blast - Prepare Operator

Get and put on protective clothing, apply tape as required, put on hard hat and safety glasses.

B. Blast - Load Machine

Use fork1ift to get and return hopper. Climb to operate values on hopper and blast machine to fill machine.

C. Set Up Air Compressor

Check oil level, start compressor, adjust flow, check at blast machine, bleed moisture from air1ine and blst machine, open and close values as needed.

D. Set Up JLG (Cherry picker)

Carry and setup blast hood, b1last hose and airhose at JLG basket . Turn JLG on, cl iimb in basket , attach safety belt, moue basket to 1location, put on hood, grasp blast nozzle,

E. Set Up on Unit

Carry blast hood to area, climb to location, put on hood, grasp blast nozzle.

F. Set Up Vacuum

Go to vacuum unit with shovel, empty dust box, position and atach tubing. Align and tape 4 pieces vac hose to unit, pull hose up ladder into unit, position, and turn on Vacuum.

G. Moue Tools for Grit Removal

Carry shovel from store to unit, up 1 adder, and position. Attach air hose to 1ine, pull to unit and up 1 adder, and position to blow down dust.

H. Remove Tools and Equipment

Reverse operations to remove blast hose and vacuum hose from unit, coi1 and stack blast hose.

I. Paint - Prep Operator

Get coveralls, put on. Put on hard hat and safety glasses. Carry face shield and spray gun to work area, put on shield.

J. Set Up Paint Pump

All operations necessary to get paint pump, attach air and paint lines, mix and strain paint, start pump and paint flow.

K. Set up JLG for Painting

Pull paint line and air hose to basket, attach. Start JLG and climb in basket. Raise to working position, attach air hose , grasp spray gun.

XI I I Assemble ‘Super Section’ on Platen, Erect in Dock - Bay (1000 Foot Bulk Carrier)

A. Rigging

Hook and unhook various sections on transporter, platen, ground, stack, in turning area. Rehook and unhook to turn on side shell. Unhook in Jig or on hull. Various operations with cables, spreader bar and shackles.

B. Layout

Measure for scribing, setup scribe block, and scribe. Set-up and take down transit on tripod (hull and ground) and on portable rail stand. Use transit with pole and tape measure. Use Plumb bob and line. Measure with 50’ steel tape. Mark with soapstone and center punch.

C. Burning

Set up, tear down and use Bug-o and hand torch.

D. Fit

Get tolls and equipment. Fit and fair with fairing clips, dog and wedge, angle butt jig, bolting dogs, bolting angle clip, and cab1e/turnbuckle. Get, use and return chain jack, bottle jack, power hoist. Use power hoist with safway and skyclimber.

E. Weld

Set up, take down, get supplies for, and use manual welding equipment.

F. Grind

Grind with portable air grinder.